Critical Thinking Forecast Process

NWP Verification & Blending Process Steps

Objective

- Given access to meteorological data, interpret numerical weather prediction products to develop a blend product IAW an evaluation checklist.

Overview

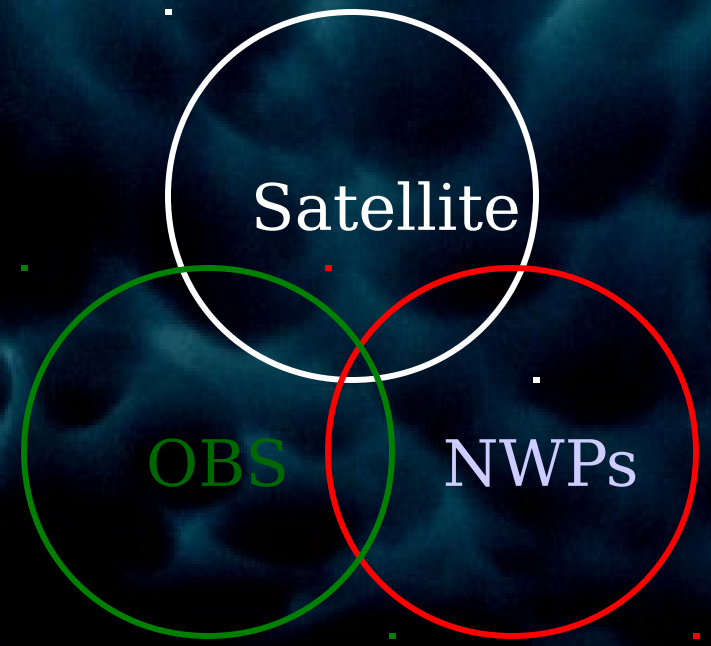
- What is Model verification
- The Critical Thinking Process
  - Step 1: Continuity
  - Step 2: Nowcast
  - Step 3: Hindcast
  - Step 4: Forecast
- What is a Blend

What is Model Verification & Blending?

- Verification is the validation of computer generated NWP models.
  - Validated against data only
    - Satellite and observations
- Blending is the merging of all available data in one more accurate product.

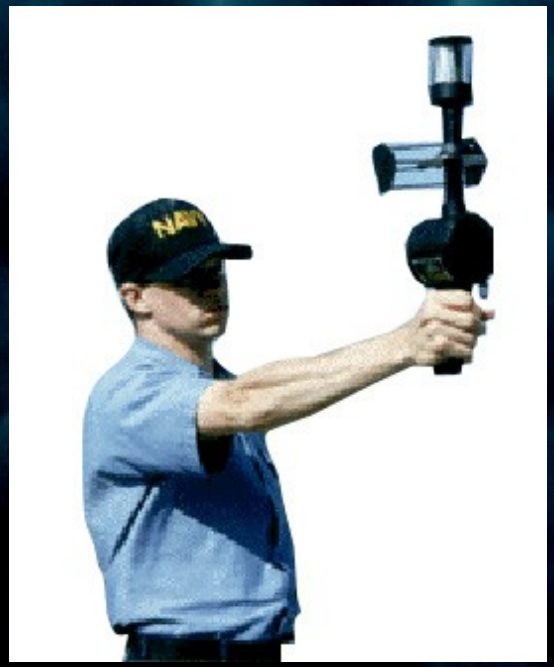
Blending continued…

- A Blend of Data
  - Satellite
  - Different observations
  - Numerous numerical models



Why Perform a Blend?

- To take the best from all sources and merge in to one product!
- Increases forecast accuracy

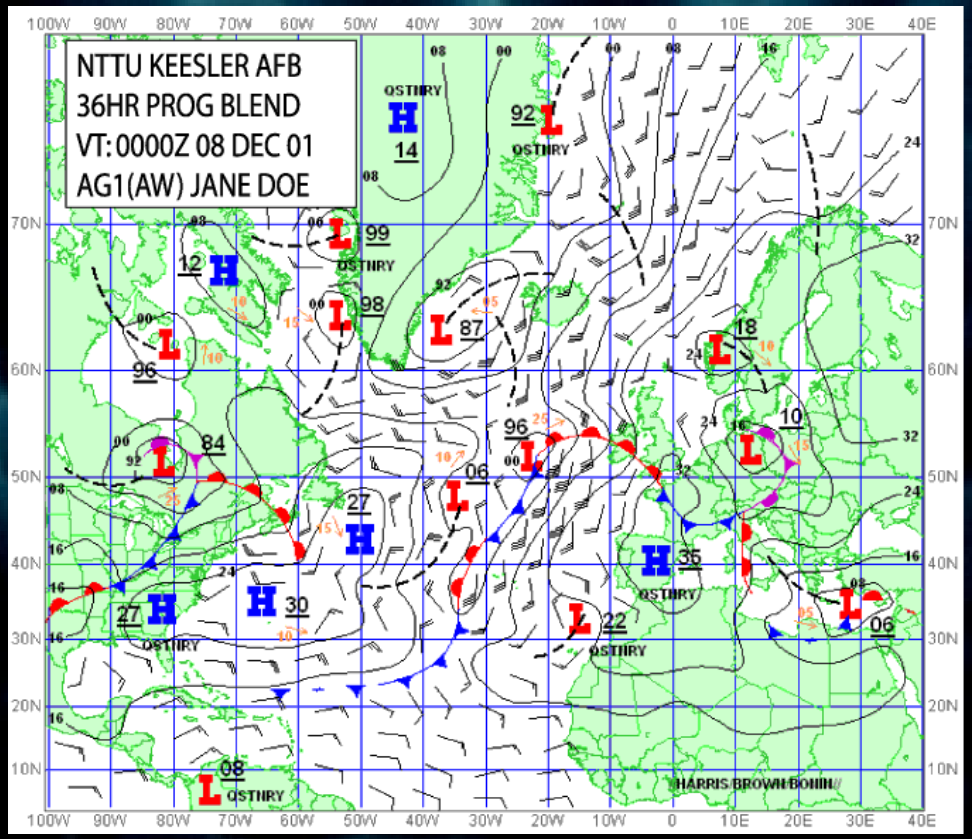


What tools are needed to Blend?

- Numerous NWP products
- All types of observations
- Assessment Products
  - Difference charts
  - Model and Satellite overlays
- Manual techniques
  - Prognostic forecasting rules
- Technical discussions
- Personal experience

A 36hr Blend example…

- This is a merger of NWP models, data, and forecaster experience.



Critical Thinking Process

- Systematic approach to help ease through forecast problems
  - First, review/know past history
  - Next, understanding the current state of the atmosphere, the NOW.
  - Then, resolve the PAST
  - Forecast the FUTURE!
- Must be able to pick a model de jour for each synoptic feature.

Step 1: Continuity– Why?

- Provides a Baseline/Foundation
- Used to Identify Synoptic Trends
- Provides same information as past-history on a hand analysis chart.
  - Previous Movement and development of a systems
  - Ridges building or weakening
  - Troughs deepening or filling

Step 1: Continuity-Tracks

- Know where systems originate?
- What were their tracks?
- Where are the systems in reference to their life cycles.
  - New
  - Still developing
  - Matured

Step 1: Continuity–SLP

- Know what the central pressure of systems were…
  - 72, 48, 24, 12, and 6 hours ago
- If matured…
  - What was the lowest central pressure during development?

Step 1: Continuity- Upper Levels

- Upper Levels
  - Where are ridges building or weakening?
  - Troughs deepening or filling?
- Possible the first levels to review since the upper levels steer surface systems

Step 1: Continuity-Importance

- Helps determine if NWP model is providing misleading information.
- Helps in making a forecast decision.
  - Most decision are can be based on common meteorological sense.
    - Example: Matures lows fill, not deepen
- Some NWP models have quirks in how they handle lows in reference to their life cycle.

Step 1: Continuity- Tips&Tricks

- FNMOC & NLMOC's WXMAP has five days of NOGAPS, COAMPS, and AVN model runs.
- Review satellite loops both forward and backwards in time.
- NRL, Monterey has satellite derived wind archives to help determine changes in the upper levels.

Step 2: Nowcast-Analysis

- Determine the NOW!
  - Afterwards, compare findings to model analysis
- Look at all data possible
- Start synoptic scale and move to mesoscale
  - Upper levels first, then lower levels
- Once finished, forecaster will know the current state of the atmosphere
  - There needs to be a confidence in their conclusions!

Step 2: Nowcast-Process

- Review satellite images
  - Visual, infrared, water vapor, enhanced
- Assess all observations
  - Upper Air, Surface, Buoy
- Utilize special sensor data
  - SSM/I, ERS-2, rainfall, 85GHZ, etc…
- If needed, look at model's analysis for hints

Step 2: Nowcast-Data

- Not all data is the same!
  - Sometimes data products from one center are better than another
- Example
  - FNMOC and NOAA Scatterometer products use different NWP models
- Now the “fine print” about each product used.

Step 2: Nowcast-Completed

- Once done, compare findings to a NWP model's analysis.
  - Look for discrepancies
    - Central pressures accurate or inaccurate?
    - Positions correct or incorrect?
- Once one model has been verified, use it as the ground truth and compare it to other models.
- Don't look at forecast charts, only the analysis!

Step 2: Nowcast-Start Big

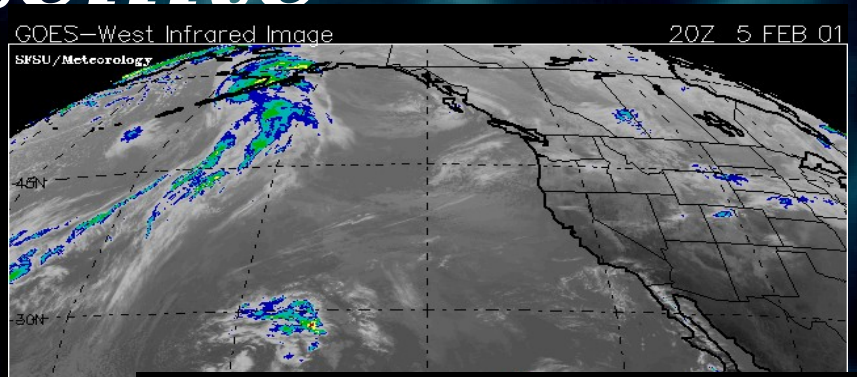
- Verify global models first to get the big picture
- Afterwards, step down to higher resolution mesoscale models
- Remember Parent-Child relationship for nested models
  - NOGAPS is the parent of COAMPS/MM5
  - An error in NOGAPS could be passed to COAMPS/MM5

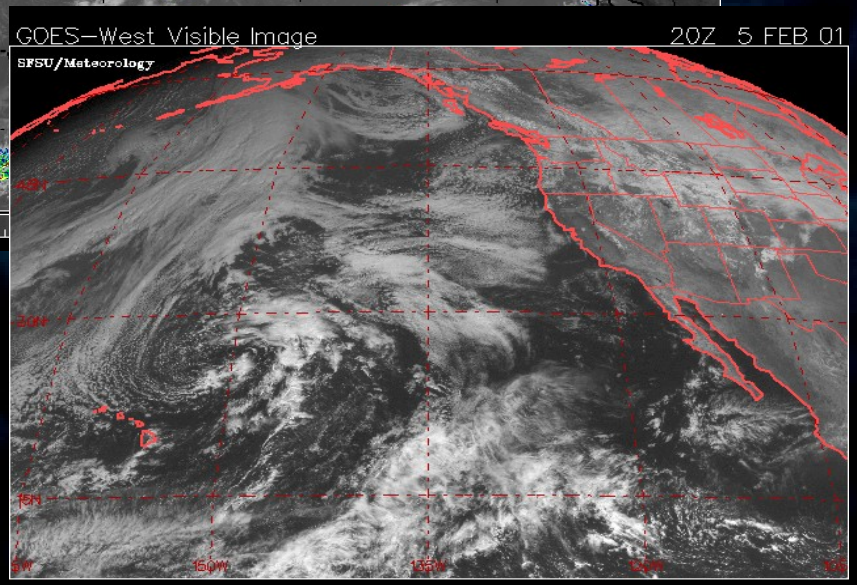
Step 2: Nowcast-Tips&Tricks

- Turn off data thinning for surface observations using JMV
  - Ensures all observations are displayed
- Compare GOES Satellite derived winds to NWP model's analysis
- Use JMV color fill ability to match model output to data products color scheme
  - Example: SSM/I to NGP/COAMPS 19 meter winds
- Use Scatterometer products and streamlining techniques

Nowcast: Review Current Satellite

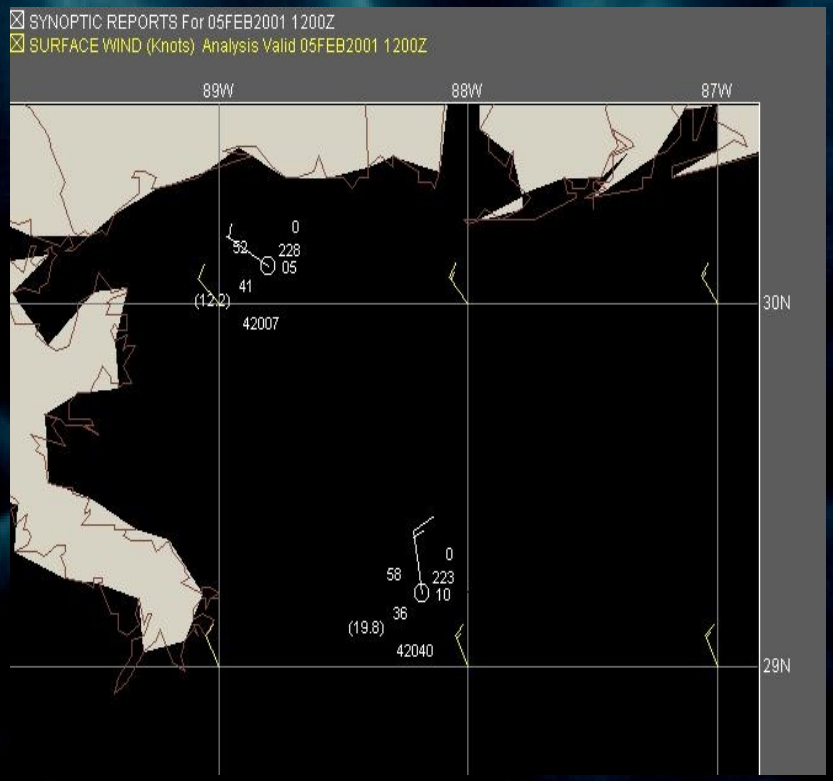
- Loop past 24 to 12 hours of imagery
  - Provides the big picture
  - Loop Forwards
  - Loop Backwards
- Visual, Infrared, Water Vapor, etc…
- ZOOM if needed!
  - This helps determine positions





Nowcast: Assess AOR's Observations

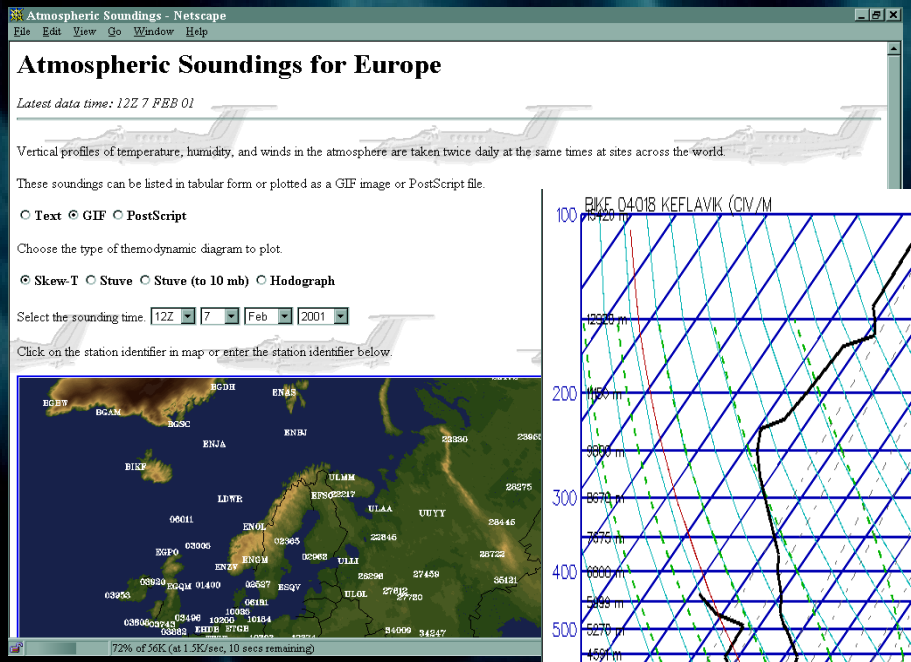
1. Take an Observation!
2. Learn what the weather is in the AOR
3. One should know,
   - Winds
   - Pressure
   - Obstructions
   - Etc..

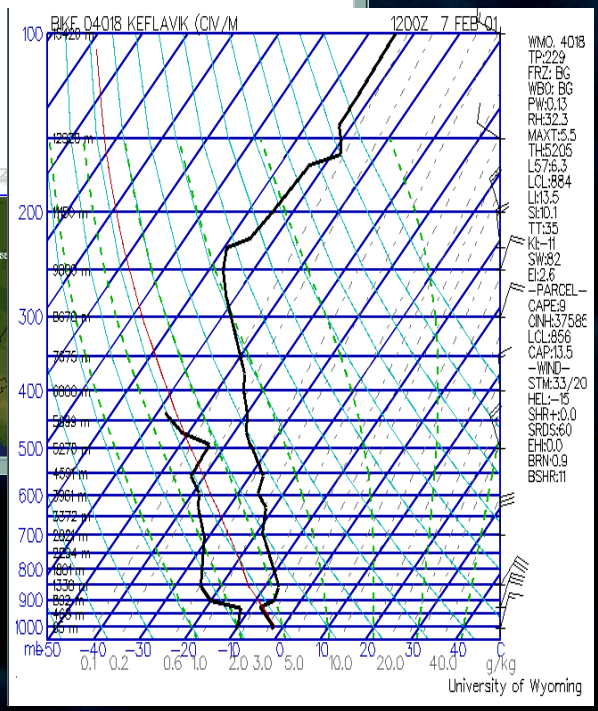


JMV review of OBS

Nowcast: Review All Observations

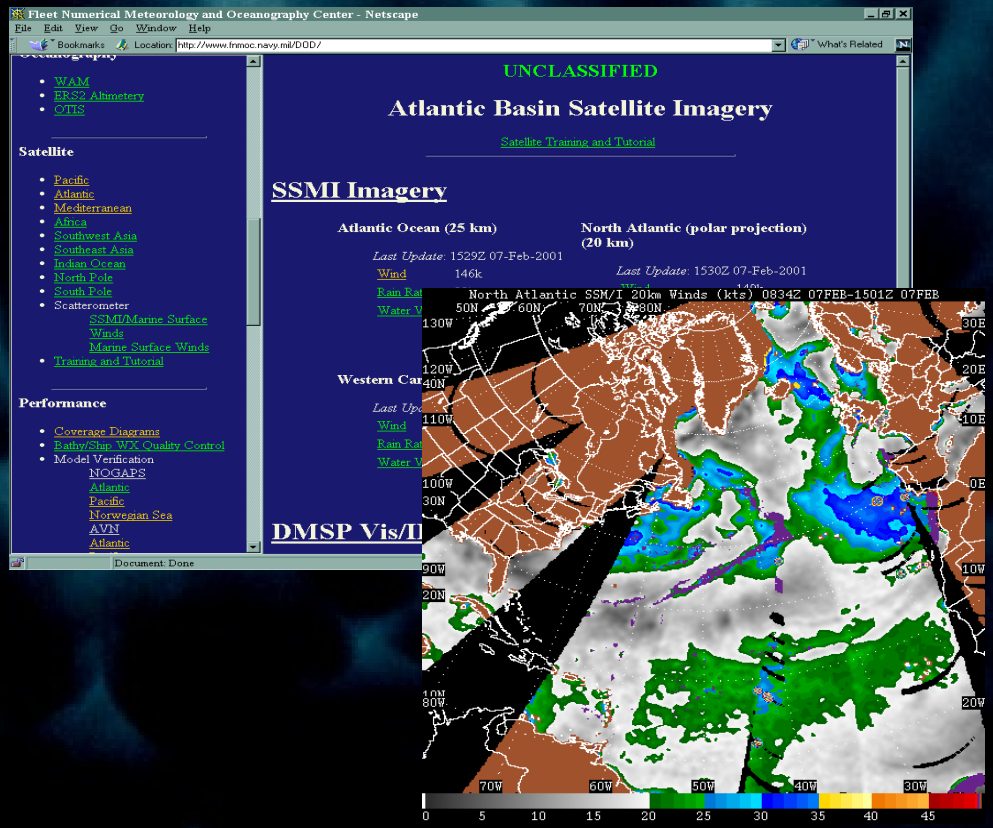
- Review all other types of observations
  - Upper Air
  - Surface
  - Buoy
  - Profilers


Atmospheric Soundings - Netscape
File Edit View Go Window Help
Atmospheric Soundings for Europe
Latest data time: 12Z 7 FEB 01
Vertical profiles of temperature, humidity, and winds in the atmosphere are taken twice daily at the same times at sites across the world.
These soundings can be listed in tabular form or plotted as a GIF image or PostScript file.
Text GIF PostScript
Choose the type of themodynamic diagram to plot.
Skew-T Stuve Stuve (to 10 mb) Hodograph
Select the sounding time. 12Z 7 Feb 2001
Click on the station identifier in map or enter the station identifier below.
72% of 56K (at 1.5K/sec, 10 secs remaining)



Nowcast: Review Special Sensors

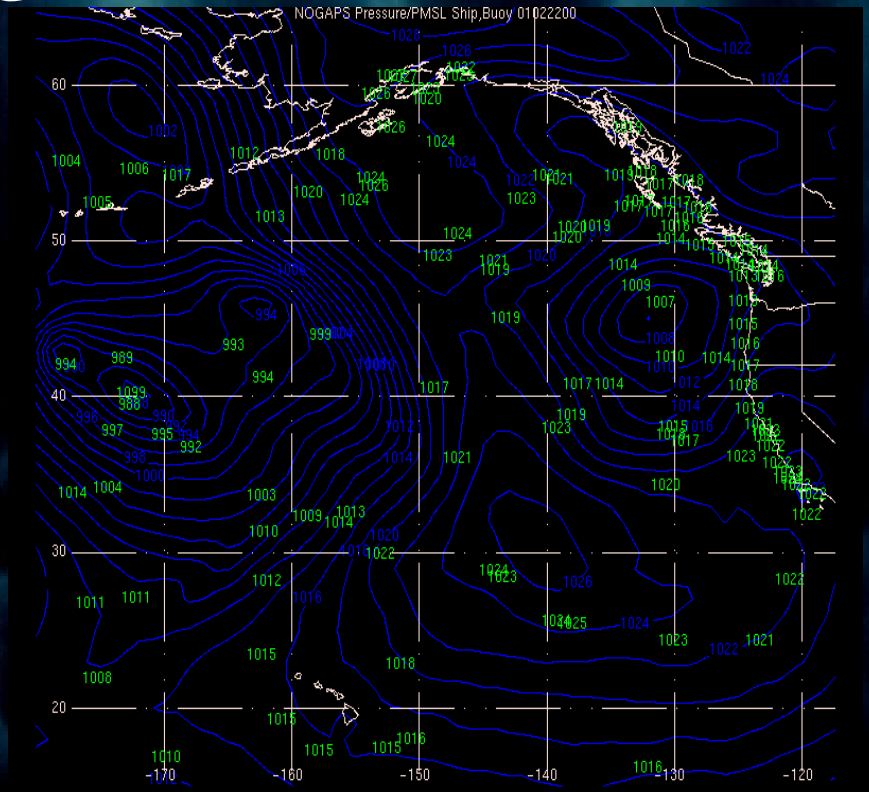
- Utilize Special Sensor data products, with established credibility, that helps assess the current state of the atmosphere.
  - SSMI –
  - ERS2
  - Scatterometer
- Always check the valid times!!!



FNMOC's SSM/I Imagery

Nowcast: Verify Model Analysis

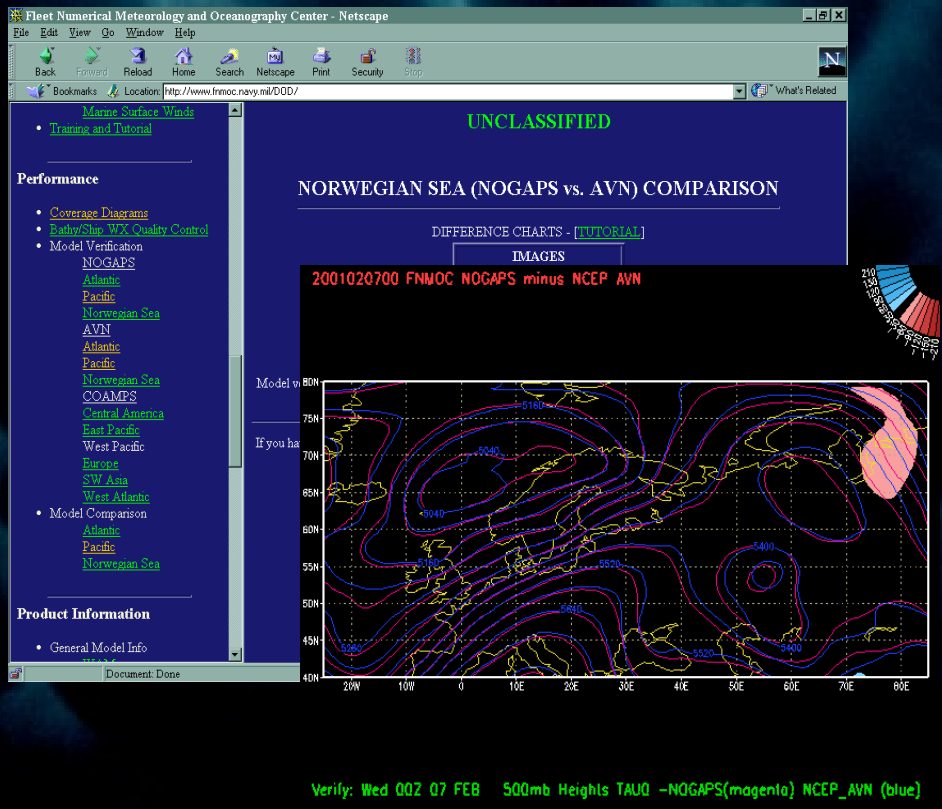
- Determine the now and ensure the NWP model has the correct depiction.
  - JMV is a great tool for this!
- Use all available data!



NOGAPS & Buoy SLP Reports

Nowcast: Perform Model Analysis Comparisons

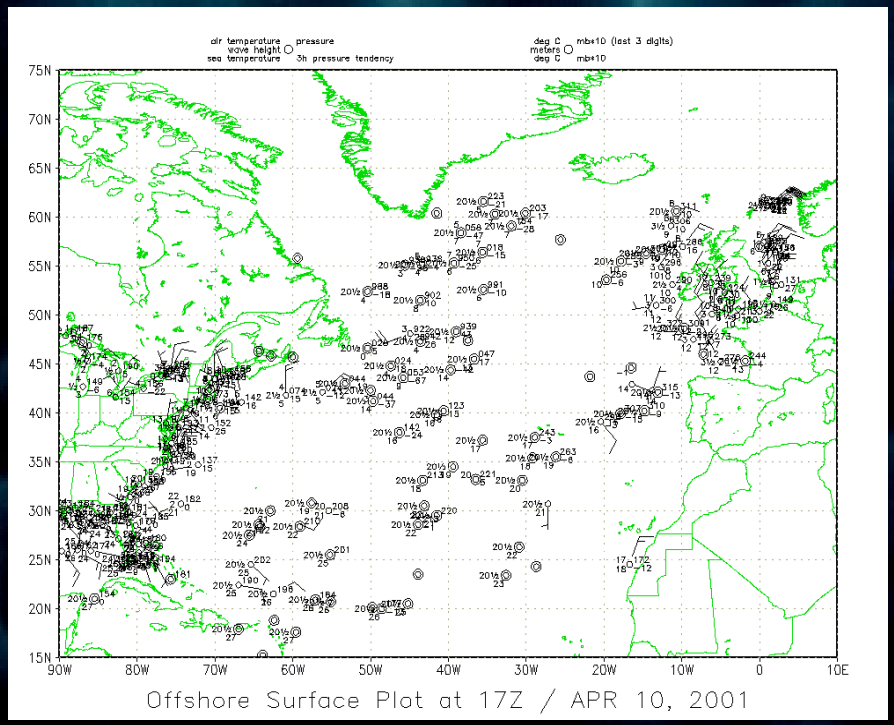
- Use previous model verification results to compare models.
- Speedy tools are available
  - Use difference chart from FNMOC for NGPS, AVN & COAMPS
  - JMV can be used and shows more details


Fleet Numerical Meteorology and Oceanography Center - Netscape
UNCLASSIFIED
NORWEGIAN SEA (NOGAPS vs. AVN) COMPARISON
DIFFERENCE CHARTS - [TUTORIAL]
IMAGES
2001020700 FNMOC NOGAPS minus NCEP AVN
Performance
Product Information
Verify: Wed 002 07 FEB 500mb Heights TAU0 -NOGAPS(magenta) NCEP_AVN (blue)

FNMOC's Analysis MVP Image

Nowcast: Utilize Other Support Products

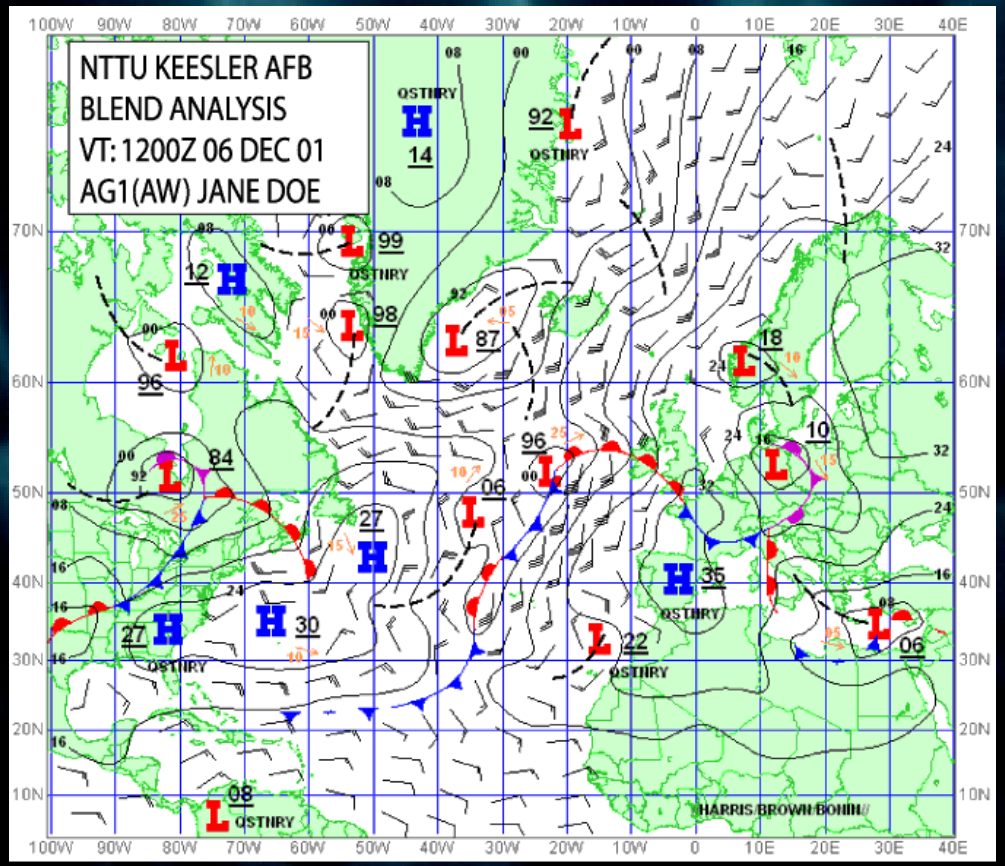
- There are numerous types of products available
- Ensure the fine details of each product is known before using it.



NLMOC's Buoy Reports

Nowcast: Develop Blend Analysis Chart

- Everything on chart has support!
- Schoolhouse technique only!
  - Normally this is a mental process
- Use NLMOC's blend chart style



larger view

Step 3: Hindcast-Model de jour

- Verify previous NWP model forecasts for errors or accuracies.
- Without an accurate Hindcast, consistency using NWP models will be difficult.
- The Hindcast information will be used in making adjustments to the forecast guidance.
- Pick a model(s) de jour for each significant system.
  - Which model(s) were most accurate?

Step 3: Hindcast-Benchmark

- The benchmark used to validate is the forecaster's Nowcast analysis, not the model's.
  - Model's analysis could misled with erroneous depictions
- Always perform the Nowcast first
- The more accurate the Nowcast, the more accurate the Hindcast, and Forecast will be.

Step 3: Hindcast-Why it works

- Most NWP centers use a model's previous forecast as a first guess.
  - This technique is referred to as a warm-start.
  - It could pass errors to the new model run
- If a model has been having a consistent error
  - The error can be anticipated in upcoming run
  - Adjustment can be made for error

Step 3: Hindcast-Tendencies

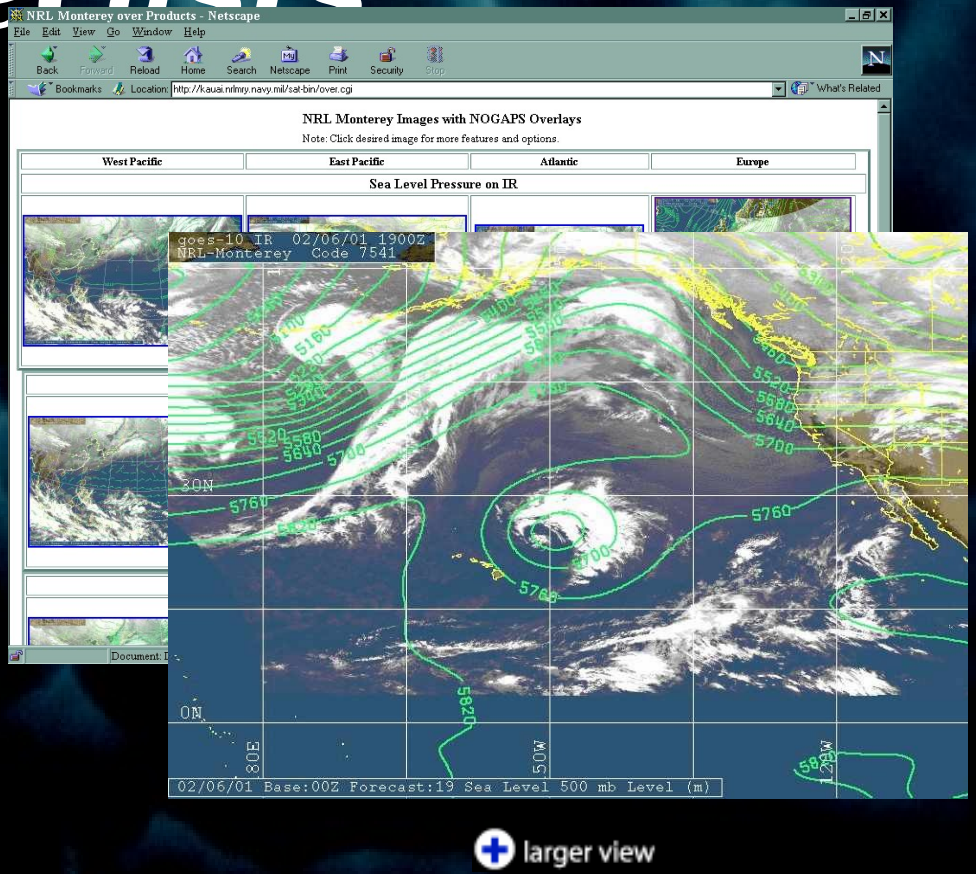
- Tendencies/biases
  - Consistent characteristic of a NWP model
  - Three sets of tendencies
    - Warm, Cold, and Transition season
- Too many to learn them all.
- Hindcast technique will display consistent model problems/tendencies
  - Review tendency pages, don't memorize them!

Step 3: Hindcast-Tips&Tricks

- FNMOC SIPRNET/NIRPNET sites have web-based Hindcast tools
- NRL, Monterey provides previous TAU12 model run overlaid on satellite images
- NOAA's HPC has hindcast tools for Eta, AVN, MRF, ECMWF, and UKMET
- JMV has archive/HWD abilities which could be used to save forecast products

Hindcast: Verify Previous Model Forecasts

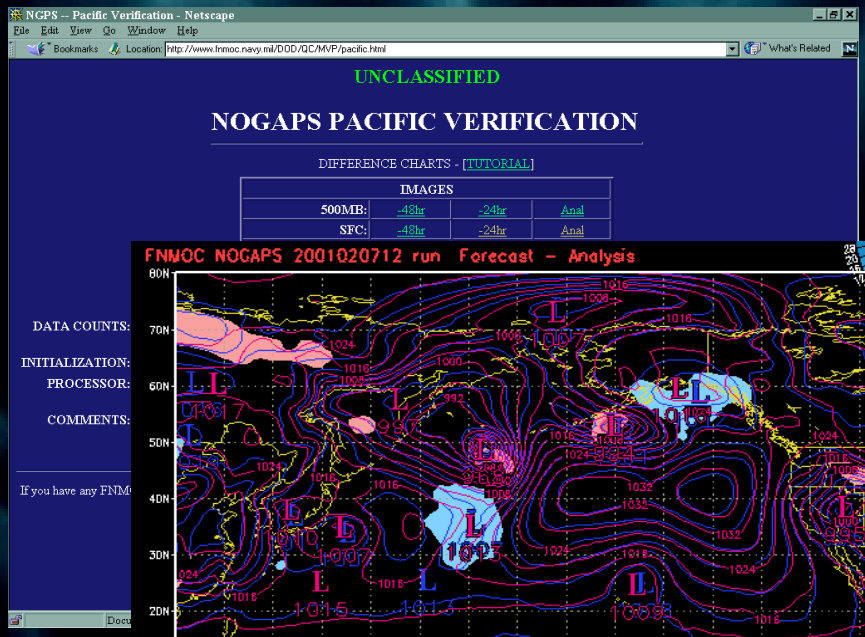
- Review Composites Products
  - IR/SFC Pressure
  - IR/500MB
  - WV/Jet


NRL Monterey over Products - Netscape
NRL Monterey Images with NOGAPS Overlays
Note: Click desired image for more features and options.
West Pacific
East Pacific
Atlantic
Europe
Sea Level Pressure on IR
goes-10 IR 02/06/01 1900Z
NRL-Monterey Code 7541
02/06/01 Base:00Z Forecast:19 Sea Level 500 mb Level (m)

larger view

Hindcast: Review Model Verification Sites

- FNMOC and NCEP have tools for performing a Hindcast.
  - Difference charts
  - Model vs Model
- If current model analysis is off, **it can't be used to verify!**
  - Use your adjusted NOWCAST



Step 4: Forecast-Apply Findings

- Access current NWP model runs and perform comparisons
- Apply determined model accuracies from Nowcast and Hindcast
- Develop conclusions based on Nowcast and Hindcast findings
  - Dynamically adjust the forecast guidance for errors
- Look at numerous models and choose the Model de jour(s)
- Formulate the final forecast

Step 4: Forecast-Alike Models

- Only compare Apples to Oranges
  - Do not compare totally different types of models
- Example:
  - Comparing low resolution ensemble to high resolution mesoscale models.
- Know what a NWP model is for and compare similar models to it.

Step 4: Forecast-Complete

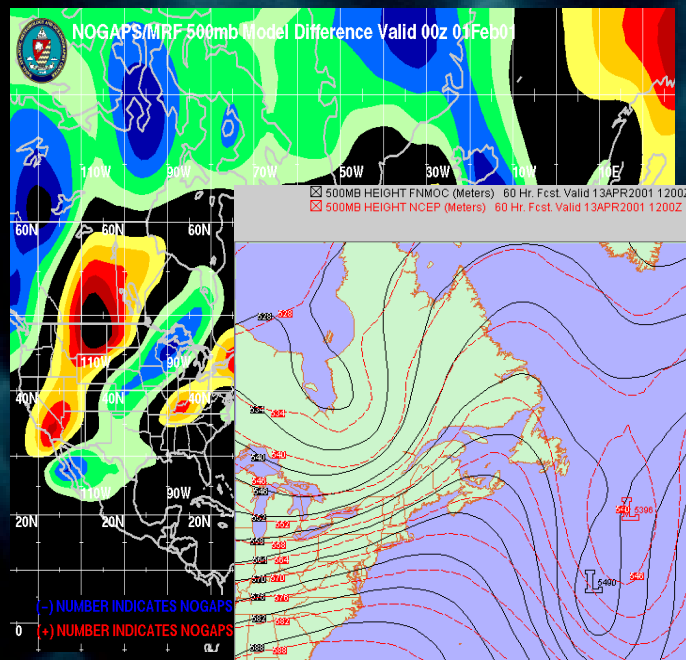
- The forecast process is complete when…
  - All model errors or strengths are known.
  - If needed, any model adjustments have been made.
  - When a forecaster can mentally, or physically, draw a forecast blend chart

Step 4: Forecast-Tips&Tricks

- Use a model viewer that allows multiple models to be overlaid one over the other.
- Start in the upper levels.
  - 300mb and 500mb
    - Steering levels for the surface systems
- If model is fast or slow determine how many hours it is off.
  - Mentally adjust your timeline in the forecast run to remove the speed error

Forecast:Assess Current Model Run Comparisons

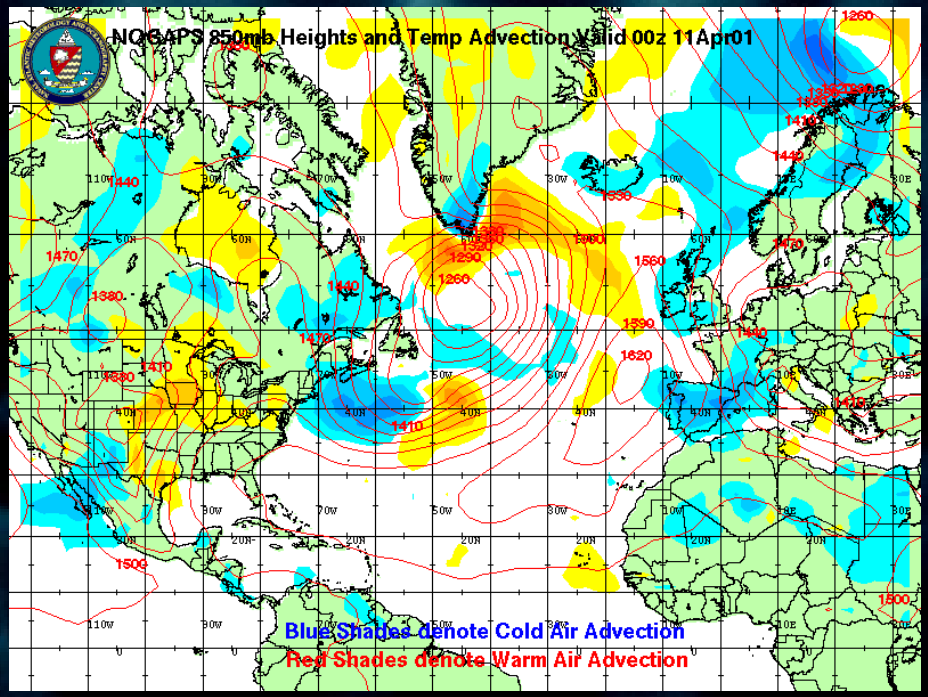
- Difference charts are quick and easy to read
  - NLMOC example shown
- JMV is very useful when comparing two different models
- WXMAP is another source



larger view

Forecast: Review Derived Prodcts

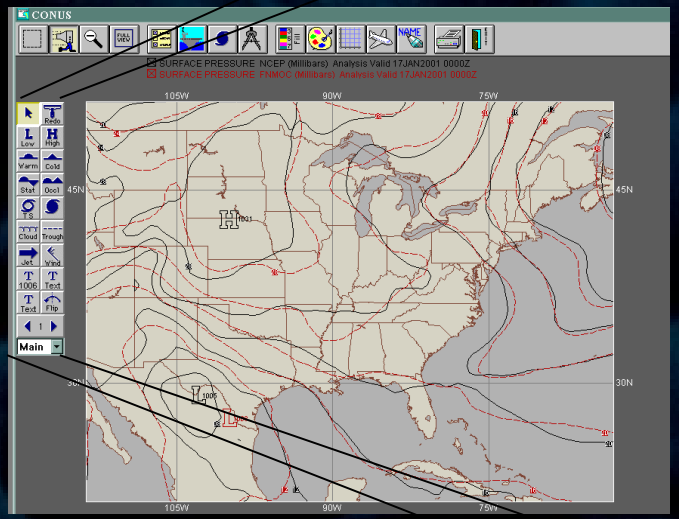
- Use all NWP products created from the model run.
  - Thickness Charts
  - Vorticity Charts
  - Advection Charts
    - Great tool for checking speed and placement of fronts


NOGAPS 850mb Heights and Temp Advection Valid 00z 11Apr01
Blue Shades denote Cold Air Advection
Red Shades denote Warm Air Advection

NLMOC's Advection Chart

Forecast: Develop 36hr Blend Chart

- Same concept as blend analysis chart
- Decisions should have proper support from data
- Also, from manual forecasting rules
- Be prepared to discuss each feature on chart



Summary

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